CMS System Design Study

Progress Report

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The CMS System Design task was started in Aug 2011 with the intention of providing an *initial* systematic study looking across the current and future NASA program of record – towards the ultimate delivery of policy-relevant data products. This task is intended to complement and look beyond the two existing pilot projects to help guide thinking about future needs. The task is expected to conclude in April 2012 with a briefing to the CMS SDT and program managers. The objectives of the study are to:

1. Engage users to define well-posed questions
2. Extract quantitative product performance goals to guide future study
3. Preliminary error analysis to predict future performance
4. Preliminary assessment of key performance sensitivities & gaps
5. Produce notional 10 year roadmap for future CMS product deployment (critical paths, incremental improvement, integration points, & key capability milestones)
6. Identify potential future needs for observations, data systems, models, & analysis; risks; opportunities; and architectural options for sustained CMS product delivery

The user engagement activity is being coordinated with the CMS Applications Task (Brown, MacCauley et al). As a result of those engagements a suite of four initial use-case scenarios have been developed; each aligned with specific policy questions and users. The following scenarios were reviewed with the science community at the September SDT meeting and the October CC&E workshop, as well as smaller dialogues with specific users such as the US EPA, CARB, and their international counterparts: 1) trend monitoring of fossil-fuel CO2 emissions from urban areas, 2) characterization of area sources of non-fossil fuel CO2 and CH4, 3) trend monitoring of major short-lived climate forcing agents (e.g., short-lived GHGs and aerosols) for developing countries, and 4) characterization of forest biomass stocks and disturbance monitoring for the US and the pan-tropics. These use-case scenarios have in turn been used to establish "level 1" performance goals[1] for key carbon data products for subsequent linking to relevant capabilities of mission data sets in the NASA program of record (and/or identification of gaps). These efforts have also identified functional needs for tools such as space-time resolved inventories to facilitate the application of inverse flux estimates to emission inventory testing.

A generalized analysis framework has also been developed, in consultation with the Biomass Pilot team, to evaluate uncertainties and sensitivities of biomass estimates for different lidar and radar data types and regression indices. This is now being applied to assess the variance in biomass estimates at different spatial scales for existing and future data sets including ICESAT-2, various flavors of DESDynI, and NASA airborne instruments.

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[1] "level 1" here alludes to requirements typically associated with NASA missions (rather than data product levels)

We plan to review this methodology and results of the analysis with experts from the biomass pilot team in February to solicit their feedback before taking additional steps.

Additionally, a framework/taxonomy for representing key sources of uncertainty in carbon flux estimates has been developed and, in consultation with the Flux Pilot team, various analyses and Observing System Simulation Experiments (OSSEs) are being executed to help construct a flux error budget and explore the driving performance sensitivities. An initial set of OSSEs evaluating the sensitivity of flux estimate uncertainty to XCO_2 measurement precision and density based on GOSAT, OCO-2, OCO-3, and a hypothetical GeoCAPE implementation have been completed on a 2° x 2.5° grid with monthly resolution. These OSSE scenarios will be run again on a 0.5° x 0.625° grid with weekly resolution with results expected in early February. An effort is also being made to assess the sensitivity of flux estimates to transport model errors.

Finally, discussions are underway with members of the INFLUX team to quantify requirements on sensing of planetary boundary layer height and other meteorological parameters to minimize error sources in flux inversions on small spatial scales (e.g., < 10 km) – including consideration of airborne remote-sensing techniques.

Efforts in early 2012 will be focused on completing the above tasks and addressing architectural considerations for sustained CMS data product delivery. We are on schedule to report out to the SDT and HQ in the April timeframe (schedule TBD).